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(54) Title: METHOD OF INFLUENCING THE STRENGTH OF A METALLIC PRODUCT

(57) Abstract

In a method of influencing the strength of a metallic product, comprising the steps of alloying a selected metallic basic material by introducing at least one alloying component into the basic material and carrying out a manufacturing process for preparing a metallic product with the alloyed material, the step of introducing at least one radioactive isotope into the metallic basic material is carried out, wherein the radioactive isotope is present in an amount causing by its decay product(s) modification of a predetermined physical property influencing the strength of the alloyed material in a predetermined manner after a predetermined period. The radioactive isotope is present everywhere in the body of the metallic product or in a part thereof.

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METHOD OF INFLUENCING THE STRENGTH OF A METALLIC PRODUCT

FIELD OF THE INVENTION

The present invention refers to a method of influencing the strength of a metallic product, comprising the known step of introducing an alloying component into the basic material of the metallic product before machining. The metallic product of the invention can be prepared by any appropriate machining technology.

BACKGROUND OF THE INVENTION

The protection of the apparatuses, pieces of equipment produced in the highly developed countries and comprising sometimes lots of different microelectronics elements against unauthorised application is a very important field of activity. The fissionable materials require also protection and it is always possible that they can get in unauthorised hands. It is obvious, of course, that the apparatuses, the pieces of equipment and the batches of fissionable materials can be manufactured by the means of technologies which are well known per se. Therefore no detailled description of the applicable technologies of manufacturing is necessary and reference to any one of the innumerable handbooks, publications is needless, with specific regard to the fact that the present invention doesn't refer to any one of the known technologies, it can be applied in all of them.

The metallic products made of specific materials and alloys and including sometimes microelectronics products re-

ceived in result of applying high-technology methods are often very expensive in contrast to the relatively simple construction of the devices manufactured or the structural elements built-in, whereamong many represent generally small value. The fissionable materials are, however, not so expensive but because of specific features require steady control, in order to avoid the unauthorised use. The unauthorised use means in this case copying, solding the product to third parties, etc. For example, a relatively simple metallic body equipped with integrated circuits comprising sophisticated solid state integrated circuits with appropriate firmware is the basic element of different antiaircraft missiles. These missiles can sometimes get to unauthorised, e.g. terrorist's hands, as it has occured soon and be used for tasks originally excluded from the commercial contract met by the manufacturer and the first consumer. The similar problem seems to arise with batches of enriched uranium fuel and plutonium have been reported to miss.

Another problem arises with the regular maintanance to be carried out by the manufacturer sometimes only after allowance given by the consumer. In this system the manufacturer can lose control on the equipment if he is not allowed to enter the place of the business of the consumer.

According to the state of the art referring to different fields of the high-technology methods of manufacturing metallic products of today no really effective possibilities are known which can be applied against unauthorised use and/ /or for ensuring conditions of exerting control on the presence and/or the state of the equipment, material.

The strength of the metallic products can be influenced by different methods. Because of the close dependence between the inner structure and the strength it is obvious that the methods of influencing the inner structure should be applicable to controlling the strength parameters. One of the most important methods is to introduce alloying components

into the metallic material. The alloys can unite the advantageous features of the metallic and/or metalloid components constituting them.

The strength depends also on the structural deficiency of the metal, i.e. on the presence of defects of the crystalline lattice and/or inclusions consisted of strange atomic groups and phases. By alloying it is also possible to modify the inner structure in order to cause change of the strength in desired direction.

SUMMARY OF THE INVENTION

The present invention is directed to creating methods of manufacturing metallic products which can be kept under practically steady control of the manufacturer also after being sold, the control being necessary either from security aspects or with regard to the requirements of the regular maintanance.

The invention is based on the recognition that the metallic products requiring the mentioned kind of control should be produced with a material system including at least one isotope which in given conditions can influence some important features, physical properties of the crystalline lattice of a part of the metallic product in a predetermined manner over a predetermined time period or after a time elapsed. This step can be carried out independently whether the metallic products constitute sophisticated appliances which may be equipped with microelectronic parts or a simply shaped basic material, as fissionable fuel. The recognition is further that a very small amount of radioactive isotopes is sufficient for ensuring the required effect, the amount being not capable of emitting radiation which is dangereous to the environment, the persons using the given product. This means, the invention proposes to apply isotopes either for "deteriorating" the strength of a metallic roduct after a

given time period elapsed or for "improving" a feature of a "deteriorated" product after a given period of time. This can be done by isotopes being active over full time of existence and by those activated by the means of a given kind of radioactive radiation, e.g. by a neutron radiation of known determined energy.

The influence exerted by different kinds of radioactive radiation has been investigated in detail by exposing different materials to the action of high intensity radioactive radiation. Of course, the results of these investigations are well-known, per se but they refer to relatively homogeneous material systems.

Hence, the present invention is directed to a method of influencing the strength of different kinds of metallic products, i. e. sophisticated appliances or apparatuses and simply shaped materials, which represents a new approach to the problem of legal safety and regular maintanance.

The proposed method of influencing the strength of a metallic product, comprising the steps of alloying a selected metallic basic material by introducing at least one alloying component into the basic material and carrying out a manufacturing process for preparing a metallic product with the alloyed material, wherein the new step lies in introducing at least one radioactive isotope into the metallic basic material. The radioactive isotope should be present in an amount causing by its decay product(s) modification of a predetermined physical property influencing the strength of the alloyed material in a predetermined manner after a predetermined period, in order to modify strength of the metallic product for excluding its unauthorised use. The metallic product can constitute a part of system comprising more different metallic elements, or form an entity.

It is an advantageous embodiment of the method as proposed the step of introducing into the alloyed material different isotopes causing by their respective decay products

processes of modifying the predetermined physical property in opposite directions is carried out, the isotopes causing the modification of the physical property respectively after different time periods.

A further object of the present invention is a method of influencing the strength of a metallic product, comprising the steps of alloying a selected metallic basic material by introducing at least one alloying component into the basic material and carrying out a manufacturing process for preparing a metallic product with the alloyed material, wherein the novelty lies in the steps of preparing the metallic product from plutonium, covering the surface of the metallic product by a dense protecting layer and introducing at least one radioactive isotope into the dense protecting layer, the radioactive isotope being present in an amount causing by its decay product(s) modification of a predetermined physical property of the dense protecting layer in a predetermined manner after a predetermined period, in order to modify strength of the dense protecting layer for allowing gases of an environment to enter the inner structure of plutonium. It is also advantageous to carry out the further step of introducing in the plutonium at least one radioactive alloying component selected from the group consisting of the titanium isotope with mass number 44, the iron isotope with mass number 55, the nickel isotope with mass number 63 and the molybdenum isotope with mass number 93.

A yet further object of the present invention is a method of influencing the strength of a metallic product, comprising the steps of alloying a selected metallic basic material by introducing at least one alloying component into the basic material and carrying out a manufacturing process for preparing a metallic product with the alloyed material, and the steps of preparing the metallic product from a fissionable metal selected from the group consisted of uranium and thorium, introducing at least one radioactive alloying

component into the fissionable metal, the at least one radi component being selected from the group consisting of the silicon isotope with mass number 32, the iron isotope with mass number 55, the zirconium isotope with mass number 95 and the molybdenum isotope with mass number 93, the radioactive isotope being present in an amount causing by its decay product(s) change of a predetermined physical property of the dense protecting layer in a predetermined manner after a predetermined period, in order to modify strength for excluding its unauthorised use.

In the method proposed by the invention it is very advantageous to introduce into the uranium and/or plutonium at least one auxiliary alloying component selected from samarium and gadolinium which are characterized by remarkable neutron capture cross-section in the thermal neutron energy range.

This solution is advantageous because of creating conditions when the manufacturer of a solid-state, particularly semiconductor device is in the position of checking the user of the device whether the last is willing to meet the requirements set in the commercial contract. It is also advantegeous that in this way the strict conditions for paying attention to regular, planned maintanance are given, too. In the case of fissionable fuels the realization of the proposed invention offers the possibility of shortening the useful life period of the fuel.

The invention will be further described in more detail with reference to some preferred embodiments of the method proposed.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to the invention some isotopes are effective to change selected predetermined properties of different metallic products, and especially those properties which are

linked with the strength of the material of the product or a part thereof. This effectiveness means that the radioactive radiation generated by the isotope introduced as a doping or alloying component into or applied as an important component in a metallic product which is e.g. a batch of a fissionable fuel or a metallic element playing important role in a more sophisticated appliance. Generally, the isotopes applied, as mentioned above are active in the moment of introduction or can be activated by the means of a determined kind and energy of the radioactive radiation. Both mechanisms may be present silmultaneously. The situation is sometimes complicated by the fact that long chains of radioactive reactions can take place which result in a higher number of different elements generated by two or more decay processes within the metallic product.

As mentioned, the present invention is based on the recognition that an intrinsic alloying (or doping) component can cause deteriorating of the crystalline lattice of a metallic material and this results in weakening of the material because of producing defects and inclusions. Weakening means in this case also the process wherein a dense impervious protecting layer made for excluding connection between a metallic body and some components of the gaseous environment (as hydrogen, oxygen, or hydrogen) becames inhomogeneous, pervious for the gases.

The isotopes applied for alloying are capable of intrinsically modifying a selected property of the inner structure being generally a less or more regular crystalline metallic material, wherein the modification sometimes ends with obtaining a characteristics of the property modified which is completely opposite to that of the material before introducing or applying the alloying isotopic component. (E.g. the electric conductivity of a material can be low or high in dependence on the amount of strange atoms produced by the isotopes and this can refer also to the strength.)

The amount of the isotopic alloying component is selected to be as low as possible for obtaining the required effect of modifying the predetermined property. This means rather an amount being lower than that generating radiation having intensity reaching the lowest allowed intensity (energy) threshold allowed by the radiation security rules. The following basic isotopes with the decay processes are proposed (see Table 1., especially the isotopes marked by x in the first column).

The isotopes as shown above, both the basic isotopes (listed up in the first column of Table 1) and those generated within the crystalline structure of the metallic act in many cases as structural gifts deteriorating at least one selected feature of at least one important layer or other component of the thin layer system forming the active part of the device. The basic isotopes (those shown in the first column of Table 1.) can be generated by the known accelerator means and added to the inner structure of different metallic products by the means of the well-known methods of alloying (doping). The metallic products where the radioactive isotopes find application are the different constructions parts of sophisticated appliances, semiconductors (integrated circuits), batches of fissionable materials (uranium and plutonium rods) produced in long series or representing special value and requiring therefore strict control during use. In an appropriate embodiment the present invention can be applied also in semiconductor devices, e. g. in a Schottky-diode which is a high- or very high-frequency semiconductor device built on an n^+-type chip made of silicon covering a carrier surface made of gold. The surface of the chip is covered by an n-type layer overlaid by an SiO_2-layer wherein a window consisted of PtSi is made. The surface

TABLE 1.

THE MOST IMPORTANT ISOTOPES APPLICABLE FOR INFLUENCING SELECTED FEATURES OF THIN LAYERS

Alloying isotope	Half-period	Kind of decay	First decay product	Half-period	Kind of decay	Second decay product	Half-period
x $^{32}_{14}Si$	710 y	1	$^{32}_{15}P$	14 d	1	$^{32}_{16}S$	
x $^{44}_{22}Ti$	23 y	2	$^{44}_{21}Sc^{m}$	3 d	3	$^{44}_{20}Sc$	
x $^{49}_{23}V$	330 d	4	$^{49}_{22}Ti$				
x $^{55}_{26}Fe$	930 d	4	$^{55}_{25}Mn$				
x $^{63}_{28}Ni$	120 y	1	$^{63}_{29}Cu$				
$^{68}_{32}Ge$	275 d	4	$^{68}_{31}Ga$	68 m	3	$^{68}_{30}Zn$	
$^{73}_{33}As$	76 d	4	$^{73}_{32}Ge$				
$^{75}_{34}Se$	120 d	5	$^{75}_{33}As$	1 s			
$^{90}_{38}Sr$	28 y	1	$^{90}_{39}Y^{m}$	65 h	6	$^{90}_{40}Zr$	
x $^{95}_{40}Zr$	65 d	6	$^{95}_{41}Nb^{m}$	35 d	6	$^{95}_{42}Mo$	
x $^{93}_{42}Mb$	2 y	2	$^{93}_{41}Nb$				
$^{106}_{44}Ru$	1 y	1	$^{106}_{45}Rh^{m}$	30 s	6	$^{106}_{46}Pd$	
x $^{109}_{48}Cd$	470 d	2	$^{109}_{47}Ag^{m}$	40 s			
$^{115}_{48}Cd$	43 d	6	$^{115}_{49}In$	6.10^{4} y	6		
$^{113}_{50}Sn$	119 d	2	$^{113}_{49}In$	2 h	6		
$^{125}_{51}Sb$	2 y	6	$^{125}_{52}Te^{m}$	58 d	5		
$^{125}_{53}I$	60 d	2	$^{125}_{52}Te^{m}$	58 d	5		
$^{137}_{55}Cs$	27 y	1	$^{137}_{56}Ba^{m}$	3 m	5		
$^{144}_{58}Ce$	285 d	6	$^{144}_{59}Pr$	17 m	6	$^{144}_{60}Nd^{a}$	

TABLE 1. (cont'

Alloying isotope	Half-period	Kind of decay	First decay product	Half-period	Kind of decay	Second decay product	Half-period
$^{147}_{61}Pm$	3 y	1	$^{147}_{62}Sm$	1.10^{11} y	a		
$^{145}_{62}Sm$	340 d	2	$^{145}_{61}Pm$	18 y	2	$^{145}_{60}Nd$	
$^{172}_{72}Hf$	3 y	2	$^{172}_{71}Lu$	7 d	2	$^{172}_{70}Yb$	
$^{174}_{72}Hf$		a					
x $^{179}_{73}Ta$	600 d	4	$^{179}_{72}Hf^{m}$	19 s	5	$^{179}_{72}Hf$	
x $^{181}_{74}W$	145 d	2	$^{181}_{73}Ta$				
$^{188}_{74}W$	70 d	1	$^{188}_{75}Re^{m}$	18 h	6	$^{188}_{76}Os^{m}$	26 d
$^{194}_{80}Hg$	130 d	1					
$^{183}_{75}Re$	71 d	2	$^{183}_{74}W^{m}$	5 s			
$^{190}_{78}Pt$		a					
$^{194}_{76}Os$	2 y	1	$^{194}_{77}Ir^{m}$	1 m	6	$^{194}_{78}Pt$	
$^{195}_{75}Au$	199 d	2	$^{195}_{74}Pt^{m}$	4 d	5		
$^{204}_{81}Tl$	4 y	1,2	$^{204}_{82}Pb^{m}$	1.10^{7} y	a		

REMARKS:

m — isomeric nucleus

KINDS OF DECAY:

1 — emission of electrons

2 — emission of characteristic and gamma radiation

3 — emission of positrons and gamma radiation

4 — emission of characteristic radiation

5 — emission of gamma radiation

6 — emission of electrons and gamma radiation

a — alpha decay

of the SiO_2-layer and the window is covered by a middle layer consisted of molybdenum or titanium which separates an upper layer made of gold from the layers lying beneath. The middle layer slows down the process of diffusion transporting gold to the lower layers of the structure. According to the invention this device can be switched off by introducing the isotope of $_{14}Si$ having mass number 32. The junction PtSi — n^+ — Si will be contaminated by the decay products of this isotope, i.e. with $_{15}P$ and $_{16}S$ having mass number 32. The mentioned middle layer made of titanium can be completed with the isotope of the titanium ($_{22}Ti$) having mass number 44. The last isotope converts itself into $_{21}Sc$ and $_{20}Ca$. The isotope of titanium applied here emits relaively weak radiation of low intensity and the isotopes of scandium are capable of emitting high energy radiation but the amount of the isotopes is low and therefore the metallic layers can protect the environment against the radioactive radiation. The source of the radiation can be applied also in the interconnections between the gold upper layer and the PtSi material of the window. According of the general practice of preparing the Schottky-diodes this interconnection should be made of an insulating material. If the isotope of the cadmium ($_{48}Cd$) having mass number 109 is applied the decay products will cause a remarkable increase of the conductivity due to generating silver. If the amount of silver crosses over a threshold level the conductivity of the junction takes up a relatively high, increased value resulting in current flowing between parts being normally insulated one from another and this fact excludes further operation of the device according to the usual requirements. Another possibility is to apply the isotope of platinum ($_{78}Pt$) having mass number 190 and emitting alpha radiation, the alpha-particles receiving each one electron and leaving the structure in form of helium, exciting thereby holes also modifying the electric conductivity

features. Another solution is to apply a conducting layer of low conductivity by adding the isotope of mercury ($_{80}Hg$) having mass number 194 which converts into platinum whereby the electric conductivity can be remarkably improved. In this case the device will operate in an uncertain manner in the beginning but it shows a "selfimproving" behaviour. The same can be effected by the means of the silicon, i.e. the $_{14}{}^{32}Si$ isotope.

It is also a preferred solution to create a doped interconnection which consists of $CdCr_2S_4$ or $CdCr_2Se_4$. The isotope of $_{48}Cd$ having mass number 109 is converted by radioactive decay into silver. Therefore the doped interconnection becomes after a predetermined period conductive. The doped interconnection can be prepared as a very thin conductor which is buried in the material of the layer system. A such conductor is practically unobservable without very specific means.

Based on the principles illustrated above the operation of different semiconductor and solid-state devices can be influenced. The laser mirrors include e.g. silver. Some amount of this silver, and particularly in a covering layer can be introduced by the means of the mentioned cadmium-chromium selenide or sulphide. So, the laser mirror will be capable of reflecting laser beam only after a predetermined time.

In the case of other metallic products two main ways of prosecuting can be followed. In the first the isotope(s) introduced are subjected to spontaneous decay which can not be influenced in any known way: the radiactive decay process can not be either slowed down or accelerated. The second way lies in introducing an isotope which is activated under influence of an appropriate energy process, i.e. it begins to be active only in predetermined conditions. The two ways mentioned can be combined.

The isotopes showing spontaneous decay are generally

(preferably those marked by x in Table 1.) introduced into the metallic products made of aluminium, titatnium, iron, nickel, molybdenum, tungsten, thorium, uranium, plutonium and the alloys of these metalls. (When a specific metal is mentioned it means generally the commercial purity grade materials if not stated to the contrary, i.e. metals including the impurities usually present therein).

In the aluminium the most important alloying components are magnesium, silicon, manganum, copper and zinc. All of the mentioned elements offer the possibility of introducing one or more radioactive isotopes, but especially the silicon isotope with mass number 32 is preferred (see Table 1.). Further alloying components are chromium, cobalt and nickel, wherein the last has an appropriate radiactive isotope with mass number 63.

The titanium basic metall is preferred to be alloyed by the titanium isotope with mass number 44.

The iron can be "contaminated" among others with the isotopes of silicon, vanadium, iron, nickel, molybdenum and tungsten. The silicon isotope of mass number 32 is rather the most important because by appropriate amount of this isotope practically all kinds of structural defects caused by the inclusions can be generated in a planned manner.

In the case of nickel the introduction of the isotopes of iron, nickel and molybdenum is especially preferred.

The molybdenum can be completed with the molybdenum isotope of mass number 93.

The isotopes of titanium, vanadium, iron, nickel and tungsten are advantageously applied to tungsten.

The isotope of cadmium having mass number 109 is especially preferred to alloys and metallic mixtures of low melting point.

The components contaminating the basic material act as structural gifts because by the decay (transformation)

processes they cause change in the diffusion mechanisms, dislocations (defects of the crystalline lattice) and inner tension. The macroscopic effects can require higher amounts of radioactive isotopes, but inclusions can be generated by low amounts, too. The inner effects can be generated in a planned manner by selecting the kind and amount of the radioactive isotope(s).

Reverting to the fissionable materials thorium and uranium can be completed with appropriate isotopes of silicon, iron, zirconium and molybdenum.

In the case of plutonium the required effects can be ensured by two ways:

i) The plutonium as basic material can be alloyed by the appropriate isotopes of titanium, iron, nickel and molybdenum.

ii) Because plutonium is a metal difficult to maintain and handle and machine, a metal which is easily subjected to structural changes by the gases of environment, as oxygen, nitrogen. Therefore plutonium is covered by a dense impervious surface layer made of gold, aluminium, silicon, nickel and niobium which can be contaminated and the decay process the imperviousness deteriorated. The most appropriate isotopes are the silicon with mass number 32 and nickel with mass number 63.

By the solutions offered in this invention it can be ensured that the fissionable fuel materials do not remain in their original state for longer time which renders possible a regular control over the fissionable materials used in the reactors and produced therein. The control is ensured by the fact that after a time the fissionable materials become inapplicable because of the slowly growing amount of strange atoms. The recovery of the fissionable material, the technology of processing of such "gifted" materials is very expensive and sophisticated therefore the control over the faith of the fissionable materials is facilitated.

The present invention is also directed to a method of alloying which together with influencing the strength is capable of improving the stability of operating the nuclear reactors in dangereous situations. It is an important recognition that the samarium (especially for plutonium) and the gadolinium (especially for uranium). The process is the following: under influence of the thermal neutrons the samarium isotope $_{62}Sm$ with mass number 150 is activated and this results in the isotope with mass number 151 characterised in the half-period 93 years and effective cross-section 14000 barns. In the uranium reactors gadolinium can be applied: the isotope with mass number 157 is characterized in cross-section 242 000 barns and comes into being by activating the isotope with mass number 156. The samarium and gadolinium is very advantageous because of showing no disturbing influence on the reactor processes up to a predetermined energy value and slowing down the same when an energy threshold is reached.

Summarised the following ways of preparing metallic products can be proposed:

i) Application of a dielectric material with isotope of cadmium with mass number 109 in the form of the compound $CdCr_2S_4$ or $CdCr_2Se_4$ for separating over a predetermined time period parts to be electrically connected one with another or for forming a conductor in a device fed with current between two parts to be separated after a predetermined time period.

ii) Application of the silicon isotope ($_{14}Si$) having mass number 32 for doping semiconductor (solid-state) devices, alloying construction elements made of iron and aluminium and glasses because of producing isotope of phosphorus having the same mass number.

iii) Contaminating important additives and structural parts of a system with a selected isotope for temporary modification of at least one important physical property.

iv) Application of isotopes emitting alpha-radiation. This is especiallay preferred in the contact regions of the appliances where electric connections should be realized. The alpha particles take up electrones and instead of electrones holes remain in the structure being electrically conductive. Sometimes even the holes are required, then this step can be made for ensuring the predetermined property after a given time period.

v) Introducing isotopes into the batches of fissionable materials in order to ensure their timely limited applicability and cooperation with a system protecting the nuclear reactors against failures.

vi) Application of isotopes in the protecting dense layers of plutonium for limiting applicability of this metal after a predetermined period.

The mentioned different solutions can be applied together or separately. They are capable of influencing selected physical properties of any metallic product including solid-state devices (also the piezoelectric and optical arrangements). Table 1 gives orientation which isotopes can be applied, and are worth of introducing.

The method of the invention can be realised with a very small amount of the isotopes which are produced nowadays in known ways, usually by the means of accelerators. It is practically sufficient to introduce the radioactive isotopes only in selected very small regions to obtain the required modification of the predetermined physical property. Therefore no danger of irradiating the environment or the persons making use of the metallic products prepared by the method of the invention exists.

The modification of the selected physical property follows always after a predetermined period. The length of this period can be controlled by selecting the amount and kind of the isotope applied, by the manner of introducing it (e.g. into a part or the whole volume of the products).

This solution gives the producent the possibility of having steady control over the fact whether the customer has the product and the danger of applying the product by unauthorised persons over a longer period remarkably decreases.

WHAT I CLAIM IS:

1. A method of influencing the strength of a metallic product, comprising the steps of alloying a selected metallic basic material by introducing at least one alloying component into said basic material and carrying out a manufacturing process for preparing a metallic product with said alloyed material, characterized by the step of introducing at least one radioactive isotope into said metallic basic material, said radioactive isotope being present in an amount causing by its decay product(s) modification of a predetermined physical property of said alloyed material in a predetermined manner after a predetermined period, in order to modify strength of said metallic product for excluding its unauthorised use.

2. The method as set forth in claim 1, characterized in comprising the step of applying said metallic product as a part of system comprising more different metallic elements.

3. The method as set forth in claim 1, characterized in comprising the step of introducing into said alloyed material different isotopes causing by their respective decay products processes of modifying said predetermined physical property in opposite directions, said isotopes causing said modification of said physical property respectively after different time periods.

4. A method of influencing the strength of a metallic product, comprising the steps of alloying a selected metallic basic material by introducing at least one alloying component into said basic material and carrying out a manufacturing process for preparing a metallic product with said alloyed material, characterised by the further steps of preparing said metallic product from plutonium, covering

the surface of said metallic product by a dense protecting layer and introducing at least one radioactive isotope into said dense protecting layer, said radioactive isotope being present in an amount causing by its decay product(s) modification of a predetermined physical property of said dense protecting layer in a predetermined manner after a predetermined period, in order to modify strength of said dense protecting layer for allowing gases of an environment to enter the inner structure of plutonium.

5. The method as claimed in claim 4, characterized in comprising the further step of introducing at least one radioactive alloying component into said plutonium, said at least one radioactive alloying component being selected from the group consisting of the titanium isotope with mass number 44, the iron isotope with mass number 55, the nickel isotope with mass number 63 and the molybdenum isotope with mass number 93.

6. The method as claimed in claim 4, characterized in comprising the further step of introducing at least one auxiliary alloying component into said plutonium, said at least one auxiliary alloying component being selected from the group consisted of samarium and gadolinium.

7. A method of influencing the strength of a metallic product, comprising the steps of alloying a selected metallic basic material by introducing at least one alloying component into said basic material and carrying out a manufacturing process for preparing a metallic product with said alloyed material, characterized by the further steps of preparing said metallic product from a fissionable metal selected from the group consisted of uranium and thorium, introducing at least one radioactive alloying component into said fissionable metal, said at least one radioactive alloying component being selected from the group consisting of the silicon isotope with mass number 32, the iron isotope with mass number 55, the zirconium isotope with mass

number 95 and the molybdenum isotope with mass number 93, the radioactive isotope being present in an amount causing by its decay product(s) modification of a predetermined physical property of said dense protecting layer in a predetermined manner after a predetermined period, in order to modify strength for excluding its unauthorised use.

8. The method as claimed in claim 7, characterized in comprising the further step of introducing at least one auxiliary alloying component into said fissionable metal, said at least one auxiliary alloying component being selected from the group consisted of samarium and gadolinium.

INTERNATIONAL SEARCH REPORT

International Application No PCT/HU 90/00002

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [4]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: C 22 C 43/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
Int.Cl.[5]:	C 22 C 43/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

AT

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	GB, A, 2 039 409 (SOCIETE ANONYME) 06 August 1980 (06.08.80), see page 1, lines 10-12.	(1)

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* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
04 May 1990 (04.05.90)	16 May 1990 (16.05.90)
International Searching Authority	**Signature of Authorized Officer**
AUSTRIAN PATENT OFFICE	

Form PCT/ISA/210 (second sheet) (January 1986)

Anhang zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

Annex to the International Search Report on International Patent Application No. PCT/HU 90/00002

Annexe au rapport de recherche internationale relatif à la demande de brevet international n°.

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned International search report. The Austrian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche internationale visé ci-dessus. Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l'Office autrichien des brevets.

Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
GB-A - 2039409		FR-A1- 2442895	27-06-80
		FR-B1- 2442895	25-03-83
		GB-A1- 2039409	06-08-80
		GB-B2- 2039409	11-05-83